

“Meeting the Project Management Challenge”  
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Forward

*Mr. A. Thomas Young addressed nearly 700 NASA employees and contractors at the First Annual NASA Project Management Conference in March 2004. In response to many requests, a transcript of his well-received speech, “Meeting the Project Management Challenge,” follows. In those instances where the audio recording of his speech was not intelligible, an “inaudible” note is inserted in the text. Nevertheless, the main body of the speech is intact and provides a unique insight into the challenges inherent in project management.*

*Conference Co-Chairs*

*Dorothy Tiffany*

*Walt Majerowicz*

[First few minutes – inaudible] Project management is also extraordinarily challenging. The criteria for success is really straight-forward. And that is to successfully achieve the project objectives within the established cost and within the established schedule. And, it’s also not much mystery as to how well you do. Because it’s pretty clear as to what the results are of a project when it is completed. The other interesting thing about project management is it’s essentially the same whether it’s in government or whether it’s in industry. And it’s essentially the same whether it’s at NASA or it’s at the National Reconnaissance Office. And, it’s essentially the same whether it’s in Boeing or it’s in Northrop Grumman. We have many [inaudible] visiting us, by the way, who managed space projects for something in excess of four decades. We’ve had some extraordinary successes. And, we’ve had some highly disappointing failures. The fundamental issue or question I think for all of us and probably what this conference is all about is, “What did we learn from all of this?” Well, in the early days of the space program, project management was a lot of trial and error, and it was a lot of “learn as you go”. Today, the benefit of the extraordinary experiences that we’ve had over the last four decades, are both positive and negative. So there’s a foundation that exists today, I believe, of fundamentals that are critical to making a project have a higher probability of success, that it might not have, if these fundamentals had been avoided. So, I’m going to spend my time this afternoon walking through a list of fundamentals that I think are important in implementing successful programs, or maybe another way to say it, to meet the challenge of project management.

My first item is organizational culture. We hear a lot about that these days. I believe that the implementing organization must have a culture of mission success, as opposed to

cost, as opposed to schedule, to make these things really happen. And, you might say, “Well, why do you believe that, why is mission success so important to culture?” I’ll offer you three reasons from a list of many. One, no matter what size project many of you may be involved in today, probably while we are sitting here right now, while we’re having this session, there are either tens or hundreds or thousands of people who are making small individual technical decisions on your project. If they’re making those decisions thinking that the criteria of cost is the most important thing on that program, probably risk is being built into that program that’s beyond what we would like. If they’re making that decision where mission success is the number one criteria, I suspect we’re on the right direction towards making the program happen.

Secondly, and often when I make the point that mission success is so much more important than cost or schedule in my view, people say, “Well you just don’t care about cost.” Not true. Cost is extraordinarily important. In fact, at Martin Marietta, I was accused of being cheap. Maybe even at Goddard too. But, there are some things we also know about managing cost, and that is if you’re running a laboratory, if you’re running a factory, if you’re running a design center, you can never achieve cost performance by managing cost. You only achieve cost performance by managing quality. If you do it right the first time, and you don’t have a whole bunch of scrap, that must be cheaper than doing it a couple times and having a lot of things to be reworked. So my argument is, mission success and quality go hand in hand. And a mission success environment really is the best part of mission managed cost.

There’s a third item. A very critical, and very important, and possibly somewhat subtle. And that is, in almost all projects, large and small, there comes a time that to achieve mission success or quality, you’ve got to make some investments. And if you have a quality first, or a mission success first, environment, then you have to think in that fashion. If you have a cost first mentality, you don’t really – if you raise a question, I think I need to make some investments, that may be a little speculative. You really need to look at it with an unusual look. Let me give you an example. Let’s say we have a group of twenty launches – just so I can do the arithmetic easy – and let’s say that each of them is worth a half a million dollars. If I could take that family, which, let me say that family has a probability of success of 90% -- that’s not unreasonable – then you’re going to lose two out of the twenty. If I could spend some money to make that 90% go to 95%, which is not unreasonable, then instead of losing two, I’m going to lose one. So, if it’s worth half a million dollars each, I actually can spend 25 million dollars additionally, on each of the twenty launches, break even financially, and have one additional success out of the family. Another way to look at it, which is even more frightening, is someone recently did a calculation as to the value of the failures in the decade of the nineties. If you take the failures that existed in the space program in the nineties, the value is 11 billion dollars. You can spend a lot of money on mission success if you can save some fraction of the 11 billion dollars.

The next question is, “Who is responsible for this culture? How do you make it happen?” I argue that this is one of the jobs of senior management – the center director, the administrator, the enterprise AA, the CEO of a corporation – these are the people who

really set the values, that are important to an organization, and typically, the values that most of us align ourselves with. If that senior executive, at all meetings, at all briefings, talks about cost – you are probably going to have a cost culture. If they talk about schedule, you’re probably going to have a schedule culture. On the other hand, no matter how difficult things get, you want to talk about mission success, you’re probably going to have a mission success culture. So, I would argue that the most important contribution to a space project that the senior leadership can make is to make mission success the primary culture of the environment into which these programs are implemented.

The next interesting question is, “How do you know when you have it? How do you really know whether it’s an issue?” Well, in introductions mentioned which, I’ve had a chance to do a bunch of these independent reviews, and in that process you trip upon a technique that seems to be pretty simple. If you ask people – enough people on a project – you pretty quickly find out. If you walk around your organization, whatever it is, and you say, “What do you think is the primary driver for how we do business?” and, they say, “Mission success”, then you’ve got a pretty good organization. And if they say, “cost” you need work. One of the things we found in some of the studies that we did, was in the nineties, that change was enormous in the direction of cost and being the driver for the enormous detriment to the program.

The next thing that I want to turn to in my items, that are fundamentals that we have learned, is that of the project manager, and the project manager staff. It’s important to recognize that the only people who can make a project a success are the project manager and the project manager staff. The president of the company can’t do it, the center director can’t do it – they can all help, they can also hurt too, possibly. But, it is that group of people who will make or break the success of a project. That said, picking the project manager and the project manager staff is extraordinarily important. Obviously you want someone – some people – with the intellectual capability to do it. That’s not hard in our enterprise. The second thing you want is some people that have leadership skills. That’s a little harder of a skill available. The third you want is experience. That is you really have to have experience for the reasons that I’m going to talk about in some of the later items – to know what it is on a daily basis you need to be successful.

If I might deviate for a second, there’s a bit of story that maybe illustrates this... There’s a group of people on an airplane. The airplane got into trouble, it’s heading down, and the pilot comes back and says to this group of distinguished people, “We’re gonna crash, and I’ve got bad news for you – we’re short one parachute, and I’m gone.” Now the President of the United States was on board and made some statements about leadership in the free world, in accordance to everything that happens in the world, and he opened a parachute and he jumped. The Pope was also on board. And the Pope made a similar statement about his role in world affairs. He took a parachute and he jumped. There was another individual on board – and I’ll let you fill in the name just so I’m politically correct – he said, “Look, I’m the smartest person in the world. There is nothing in the world that happens, that if I’m not involved in it, that could possibly come out correctly.” He took a parachute, and he jumped. Then you’ve got two people – you’ve got a minister and a student – and one parachute. The minister said, “Son, I’ve lived a good life. You

take the parachute and you jump.” The student said, “Sir, everything is fine, don’t worry about it.” He said, “How can everything possibly be fine? We’ve got two of us on the plane. It’s gonna crash, and we’ve got one parachute.” He said, “Sir, the smartest man in the world just jumped out with my backpack.”

Project Managers have got to be smart enough to know the difference between a backpack and a parachute!

There are some instances where you’ve just got too many programs and you can’t have the experience – so what do you do? Then, you’ve really got to have a mentor who plays a significant role in working with that program manager in executing the program. The other thing we’ve found, not so much in NASA to my knowledge, but when we looked at DOD activity, average tenure of a DOD project manager is about two years. Even less, actually. No way can you successfully manage something as sophisticated as we’re doing with a turnover every two years. Continuity is important. If you have a mission success culture and implementing organization, and if you have an experienced program manager and program management team, you’re well on your way to having the fundamentals in place.

Let me turn to a couple of others that are critical. The next item on my list is to recognize that space is different. Space is different than experimental airplane, it is different than a stealth ship, it is different than a sophisticated tank, it is different than a high performance wind tunnel, it is different than a challenging ground system. It is different in the following regard – in space or a space project, thousands of people do everything perfectly. One human can make one mistake, or there can be one technical flaw, that got through the system, that can result in the program being mission catastrophic. It’s what I refer to as a “one strike and you’re out business”. One of the reasons I that go back in experiences so far, is to recognize that fact – that it is different than a lot of other technological things that we do, that are very challenging, but most of the time you get a second or a third strike. This is one of the few things where it’s a one strike and you’re out kind of the business.

Well, it’s clearly incumbent on all of us to try to minimize human errors and to keep a flaw from existing. But, no matter what we do, we will not eliminate human error. Human error will be there in some nature, and it’s just not possible to eliminate it. So, what do we do about it? What we do about it is, we have a safety net. We have a safety net with high hopes. So what is the safety net? The first is testing. The most valuable, independent way of verifying a system both technically, and also from workmanship, is testing. If you can test a system like you’re going to fly it, and then if you fly as if you’re testing, you’re pretty much eliminating along the way a lot of failures that we see regularly. If you look at the CAIB report, and look at simply the bowl catcher – flying with the bowl catcher not having been tested, was not flying as we expected. I’ll come back to that.

There are some things that you just can’t test. Software systems can be so sophisticated that you can’t do a full test program. The next best thing is independent verification and

validation. And, at the risk of getting into a lot of trouble – but for me that’s okay right now, I don’t mean West Virginia IV and V. I mean IV and V where you really go through and you look bit by bit, and element by element. That’s done on many programs. The Titan IV does it. On Viking we did it for the entry software. Not all software, but for the entry software.

There are some times where you can’t test, and the IV and V won’t do it for you – as an example, the installation of a solid rocket motor – and in that instance, then an inspection becomes the safety net. And, we have been taught in this modern way of doing management, that everybody does self-inspection. And, there is nothing wrong with that in defense electronics or areas where you get a second strike. But, in areas where you get one strike, self-inspection is not good enough. If you are doing something that there is no other way to verify whether it was done correctly or not, a second set of eyes is always our advantage.

The one thing I really want to highlight in this aspect of my comments is that when you don’t have a complete test program, or if you fly differently than you tested, or if you leave a void there, don’t confuse that with taking a risk because that’s not taking a risk. If you do that, you’re gambling – because you don’t have any idea of the outcome. If you have not done the complete test program and you operate... if you fly something differently than you tested it, it’s not a risk issue, it’s a gambling issue where you don’t know what the outcome is. And, therefore, you don’t know how to mitigate the outcome. So keep in mind that there’s an extraordinary difference between taking risk – which I am an advocate for, because then you can mitigate it – as opposed to gambling.

The next item I want to turn to is budgets. When we did a look at a National Security Space programs you’ll find that a lot of them are in some serious trouble. We found out that the largest problem of the flawed programs was budgets that were inadequate that led to unexecutable programs. There is a lot of confusion about what is the ramification of an inadequate budget. First off, let me tell you that I believe that for a program to be successful it must be budgeted at a most probable cost. And within that most probable cost must be approved reserve. And, I’ll touch on that a bit more in a minute. Failure to do so – there are a lot of consequences, but I think you can put them in a few categories. One is, it could be a project that is inadequately funded, and somewhere down the road you figure this out, and you add more money into it and you proceed on. There are other projects, which are inadequately funded, that you never correct, and in essence schedule becomes a reserve and the program is moved to the right. There’s another kind of program where the schedule is not available to use as a reserve, say a planetary program, and then risk becomes a reserve. Let’s look at these three possibilities and why I think an under-funded program is such a flawed program. If you take a circumstance where you’re findings are that extreme, you’re usually at CDR, when everybody would really agree, “hey we’ve got a real budget problem.” The brutal circumstance you have is two-fold at that point – one is, I don’t know what the multiplier is, but I argue that it’s at least a factor of two. It’s more expensive to correct a problem at CDR than if you did it right to start off with. Secondly, if you’ve had to worry about all of those decisions, all of those analyses, and all of those tests that were run and not budgeted for enough, when the

program was under contract, so even if you add the money, you're probably going to double how much you add, to the cost of the program, and you've got probably risk built into the program. A DOD program, which you read a lot about today [inaudible], which is extraordinary for a program for national security went through that in its early life.

A second kind of program, well you have a pretty good, well you have an outstanding program manager. And the program manager recognizes that he or she doesn't have enough money. And, so what they do in the fiscal year, they spend all they have as best they can. And what they don't accomplish, they move to the right. And they continue to do that over time, and eventually there's a big bubble out there some day, and all of the sudden, everybody's surprised. There's an enormous cost problem on the program. Space Station fits in that category. A five billion dollar bubble that popped up, a schedule that was, prior to Columbia, four years late, with a redesigned program. And, you could actually – I would actually, compliment the program managers in that regard because it sounds crazy but they were doing the best they could with inadequate funding, without jeopardizing the technical accomplishments of the program.

The third is the most worrisome. And that is, you have an inexperienced program manager who's going to say, "I'll show you what I can do." Or, you have a circumstance where the schedule is fixed – like a planetary program. You have an inadequately funded budget, you can't get anybody's attention to the problem. So, what do you do? There's only one margin left in that program, and that's risk. So what you do is you cut back a little on testing, you cut back a little on analysis, and you have less systems engineers involved, and before you know it, this little increment to risk. Nobody is going to take a risk if they think it is going to cause a program to fail, but these little increments of risk are a little bit like radiation, and that is they accumulate until they become fatal. And you have a failure. MARS 98 is just this program, and that's just what happened. MARS 98, where we had a lander fail, an [inaudible] fail, and two probes fail. So, my argument is as important to mission success as anything else, is budgeting for the most probable cost. I argue that the most probable cost [inaudible] is those people who do this in a statistical way, and there are people out there who probably know a lot more about it than I do. But it's in the eighty percent probability that the most probable costs exist in the kind of program we're talking about. A lot of argumentative people say, "50/50 must be the answer." Well, if you think that 50/50 is the answer, then whatever program you're thinking about is, there is an equal probability of being a year early or a year late. And I doubt if there is any program where you can think that there is an equal probability of being a year early. The problem is that the profit – it's not a symmetrical distribution; the problems are skewed to the right. And that's why it is 80/20. So now if you buy that and rebudget it with 50/50, which we find a lot of people do. The difference between a 50/50 and an 80/20 is about 25%. So now if you take a big program – a five billion dollar program, I've got a program that the most probable cost is five billion dollars and if I budget it at 50/50, then I'm going to budget at 25% below the probable cost. So, I'm going to budget it at about 1.3 billion dollars below what is probable. That program, on day one – on day one, when you start that program – the most probable outcome is an overrun of 1.3 billion dollars. There's a worse circumstance that exists, and that is that you use the contractor cost proposal. A contractor's cost proposal is really on a cost-plus

[inaudible] program. Contractor's cost proposal is the lowest reasonable cost – whatever you want to call it, I would statistically say that it's about 20/80, and if you say, "Why do people do that?" – it's because it's working against them, pure and simple. So if you've got a contractor's cost proposal that's 20/80, and you go to the senior management wherever it is – DOD, NASA, Congress – and they say, "What did the contractor bid?" And you say, "X", and they say, "Well, that's what were going to use". No, no... do you know more about cost estimating than industry knows? Your answer will always I suspect be "no". And the problem is that's true, I mean industry does know better what it's going to cost, I believe than typically the contracting organization. The problem is it's just not the cost proposal. And the point I'm really making is, if somehow or another, the programs use the contractor's cost proposal for their budget at about 20/80. Then what you will find is another 25%. So now there's a 5 billion dollar program and they've only budgeted 2.5 billion dollars and everybody is all happy. And the most probable outcome on day one before anything is done, that program will overrun 2.5 billion dollars.

So, when you hear people say, which I've heard all my life, boy what we're going to do on this program, we're going to hold the project manager's feet to the fire. When your boss says he's going to hold your feet to the fire, you want to find another boss, would be my argument. It just doesn't work that way, because holding the feet to the fire and the most probable outcome is what I planned to talk about results in a lot of possibilities. It can be an inefficient program – it will clearly be more costly than 5 billion dollars. It could be a program that could have years of delay, like Space Station, or it could be a program where failure is almost a planned outcome, like MARS 98.

I want to come back and hit a couple of other items. The other item that's necessary as a fundamental is, most of the programs that were interested here in talking about, our sponsoring organization is the government. If there's any thing that I think we've learned out of this is that the government has to have extraordinary capabilities to manage these programs. The government has to have capabilities, not just in doing contracts, but has to have program management capabilities, systems engineering capability, contract and cost estimating, risk management – all of that. There is an enormous necessity for capability in government to make these things work. In addition to that, the best thing a contractor can have, is a competent buyer, or a competent program officer. The other thing that's critical is, there is some healthy interaction between two competent organizations. One plus one, well they really become three. You better understand problems, you'd better get to the right solutions, you'd better come to the correct analysis. In DOD, in the nineties, there was something called "acquisition reform". The fundamental is that we want to give this all away to industry and do away with the government's capability. NASA did a little of that too.

I want to hit two other items and that list could go on. One is that these programs are critically in part of, to understand its "kind of a one strike and you're out kind of business is" independent program assessment – there's no substitute for it. Having a second and third set of eyes looking at something is invaluable. And, wherever your organization is, wherever you are, don't become insolent. Don't become wedded to the fact that you

know more about it than anybody else. It might even be true, but still a second and third set of eyes can provide an enormous contribution in understanding risk and how to mitigate risk.

I talked an awful lot about cost. The other thing that's critical about cost is independent cost estimating. Almost everyone on a program when its being started is an advocate. And that's good, I mean there's nothing wrong with that, but there's got to be some people who are doing independent program assessments, largely systems engineers, some people who are doing independent budget assessments, largely independent cost estimators, who are putting realism to the program. When I was in industry, my view of this, was sometimes for strategic reasons you take some financial or budget risks, that are necessary to the program. However, there is no excuse for not knowing, no excuse for not knowing what the real cost is, what the real technical risk is, and what the real schedule issues are.

The last item I want to talk on is something to be wary of. Senior Management says, "I've got this new thing that's really going to save a lot of money." Your antenna should really go up. When they say, "I've got this new concept of acquisition reform – I'm going to move everything to the contractor, and we're not going to worry about this", worry about it. When somebody says, "Look, we're going to implement faster, better, cheaper..." By the way, I'm an advocate of "faster, better, cheaper" – the problem with "faster, better, cheaper" was, it wasn't defined. Fundamentally, everybody was left to make up their own rules as to what it was to implement. So when somebody says, "Look, I have this technique", like "faster, better, cheaper", ask, "Tell me a little bit more. Tell me where's the implementing policy, where's it written out, where's the test and the analyses." And, when someone comes along and says, "Look, we're going to reinvent government. We're going to take those functions that government is now doing... really industry kind of functions, I'm talking about the space groups...worry about that ". Whenever budget becomes a problem for leadership, people say you re being too conservative, you just have to take more risks, that's ok, but be sure you understand if you are eliminating non-value-added functions, or doing things, or you mitigate the risk. I would argue the cumulative cost of flawed policies largely, is risk, which was a big part of the flawed programs of the nineties.

[inaudible closing comments]